

Forensic Age Estimation Using Cameriere’s Seven Teeth Method: A Radiographic Study.

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Abstract

Age estimation plays an important role in identification of deceased victims, criminals and also is of particular interest in dentistry for treatment plan. Cameriere et al proposed a method for age estimation by measuring the open apices of 7 left mandibular teeth on panoramic radiographs. The present study was aimed to determine the dental age using Cameriere's method and to compare the chronological to estimated dental age. The study comprised of 72 subjects ranging from 5-15 years of age. Dental age was assessed by using Cameriere’s 7 teeth method on panoramic radiographs. Statistical analysis showed that all the morphological variables were significantly correlated with age and a regression formula was derived. The present study concludes that Cameriere’s method is reliable for age estimation in the sample and therefore age can be estimated with a good degree of accuracy using derived formula.

Keywords: Dental Age, Chronological Age, Cameriere’s Method, Age Estimation, Panoramic Radiograph.

Introduction

Age estimation is an integral part in forensic medicine and dentistry in order to identify the deceased and accident victims. Recently the use of age estimation has become inevitable due to the increase in criminal activities. It is mostly used for legal responsibility and for other social events such as birth certificate, marriage, joining the army and retirement etc.¹ Due to the lower variability in dental indicators, the use of dental maturity in estimating the age of individuals have become one of the important aspect in forensic odontology. Assessment of the eruption of teeth either by visual or by radiographic method can be used to estimate the dental age in children and adolescents and is of particular interest in orthodontics and pediatric dentistry for making accurate diagnosis and treatment strategies.²

Various methods have been carried out to estimate the age in forensic odontology and the most commonly used method is by assessing eruption phases within the acceptable error limits. Basically these methods define the stages of mineralization of teeth observed in radiograph and code them according to the predetermined scores. The easy availability of dental panoramic tomographs has improved the visualization of different developmental stages and eruption status of all the teeth in a single radiograph.³ Roberto Cameriere et al proposed a method for age estimation by evaluating the measurement of open apices in teeth, sum of the normalized measurements of open apices and N_0 (number of teeth with apical end of root canal completely closed), age was shown⁴. The present study was done to evaluate the feasibility and accuracy of this method in the study population.

Materials and method

The study was conducted in the Department of Oral Medicine & Radiology, Yenepoya Dental College & hospital, Yenepoya University, Mangalore. After obtaining Ethical clearance from the Institution, 72 panoramic radiographs of patients between the age group of 5 to 15 years that have been taken for various diagnostic purposes were collected from the archives. Radiographic images were retrieved using Agfa NX software and displayed on the computer screen. Radiographs of individuals with developmental anomalies like hypodontia and hyperdontia, any diseases affecting the bone and faulty radiographs were excluded. The chronological age is calculated by subtracting the Date of Birth from the Date of Radiograph taken. The dental age was assessed by using Cameriere's seven teeth method. Seven permanent mandibular teeth on left side were valued. The number of teeth with complete root development (N_0) was calculated. Then the measurements of the open apices of teeth with incomplete root

development are taken and normalized by dividing it with the tooth length [$X_i = A_i/L_i$ where, $i = (\text{tooth No. } 1 \text{ to } 7)$]⁴. For teeth with one root, 'A_i' = distance between the inner side of open apex. For teeth with two roots, 'A_i' = sum of distance between inner side of two apices, 'L_i' being the length of the tooth (Figure1). For each individual, all the morphological variables N_0 , X_i and S (sum of all the normalized measurements) were entered in an EXCEL sheet to be used as predictive variables for age estimation in sequential statistical analysis. Correlation coefficients were evaluated between age and predictive variables. To estimate the dental age a multiple regression model was developed by selecting morphologic variables that contributed significantly to age estimations using the stepwise selection method.

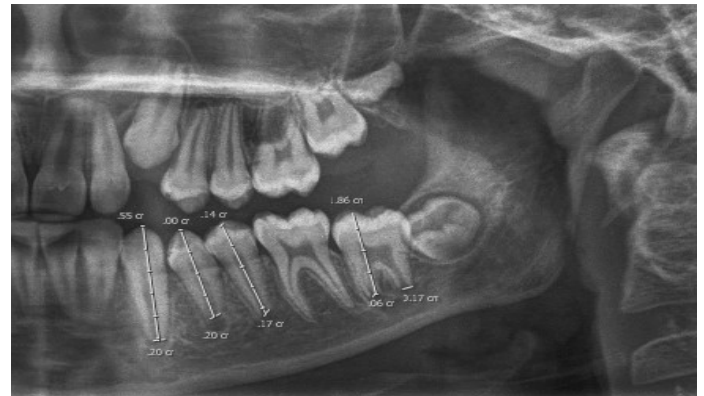


Fig 1: Shows measurement of mandibular left seven permanent teeth. Incisors and first molar apex appears closed; hence designated as N_0 . Tooth length and width of open apex of canine, premolars and second molar measured.

Result and observation

Pearson's correlation coefficients between chronological age and morphological variables showed that there exists moderate correlation between age and the parameters observed. Multiple regression models with step wise method were used for the analysis. The variables N_0 and X_7 contributed significantly to fit the equation with an R square 0.765 [Table 1 and Table 2].

Thus, these variables were used to derive the linear regression formula.

$$\text{Chronological age} = 12.015 - 3.731 * (x7) + 0.325 * (N0)$$

Table 1 - Model Summary

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Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.855 ^a	.732	.728	1.2081
2	.875 ^b	.765	.758	1.1396

a. Predictors: (Constant), x7

b. Predictors: (Constant), x7, N0

Table 2 – Coefficients and significance.

Model	Unstandardized Coefficients		Standardized Coefficients	P value
	B	Std. Error	Beta	
(Constant)	13.392	.201		.000
x7	-4.962	.362	-.855	.000
(Constant)	12.015	.485		<0.001
x7	-3.731	.524	-.643	<0.001
N0	.325	.105	.279	<0.003

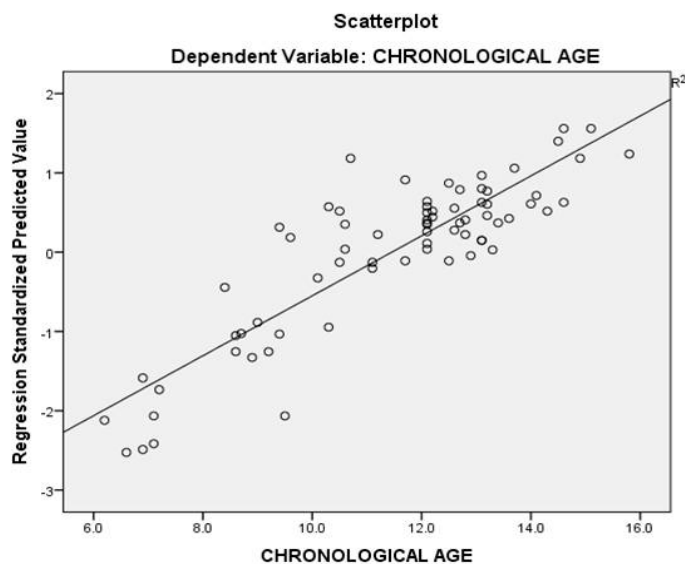


Fig 2: Shows the scattered plot of the chronological age vs. predicted age which suggests that the values are equally distributed and hence, the regression model fits the trend of the data reasonably well.

Discussion

Age is one of the essential factors in every aspect of life, research, court of law and in clinical practice. Hence the need of age estimation in living individuals is becoming increasingly important. Dental maturity is less susceptible to nutritional, hormonal and pathological changes, particularly in children. Hence, dental age is considered to be vital in establishing the age of an individual. Different morphological stages of mineralization correlate with the different developmental stages. The aim of the present study is to estimate chronological and dental age in individuals from Mangalore between 5-15 years of age. This age group is commonly accepted for dental age estimation in children as teeth development passes through various stages during this age group. The radiological method is one of the most reliable methods available for age estimation which is widely used for both dental and skeletal method³. In the present study dental age has been assessed by using panoramic radiograph, following the method described by Cameriere, which is widely accepted and has been studied extensively on various populations by many authors.

Cameriere L et al⁴ conducted the study on Italian population of children aged between 5-15 years. The study was based on seven mandibular left healthy permanent teeth for assessing dental age by measurement of open apices in teeth. Statistical analysis showed a significant correlation with chronological age and morphological variables with R square 0.836. In their study the second premolar contributed significantly to the fit, however in the present study second molar and no. of teeth with closed apex contributed significantly to the fit. In our

study, statistical analysis indicated that there exists significant moderate correlation between chronological age and the parameters observed with R square 0.765 but only the variables 'normalized measurement of second molar and number of teeth with closed apex' contributed more significantly and were therefore included in the regression equation. From the study it was also found that the estimated age of females and the group below 8 years of age was more significant.

A study was performed by Balwant Rai et al⁵ to determine the accuracy of Cameriere et al equation on Haryana Population for age estimation from open and closed apices. They have selected orthopantomographs of 259 healthy children aged between 5-15 years were selected. They have observed overestimation of age by one year in 20 percent of females and 25 percent of males. Hence they have concluded that the regression equation obtained by Cameriere cannot be used for the Indian population as it may show difference due to the geographical, genetic and environmental factors. However the present study is conducted by generating a new regression equation which did not show significant difference between the chronological age and the predicted age.

Tapaswini Bagh et al⁶ had the conducted study to estimate the dental age of Mangalorean children between the ages of 5-15 years by using Cameriere method in panoramic radiographs. The mean chronological age of the sample were 9.83 ± 2.83 years and by Cameriere method 9.88 ± 2.15 years and there by showed no statically difference between the two. For the Intra class correlation coefficient showed (ICC = 0.971) excellent agreement between Chronological age and ages estimated by Cameriere method. Therefore their study indicated that Cameriere method was reliable for age estimation in the sample and hence age of the subjects can therefore be estimated with a good degree of accuracy using this method.

Chandhini et al⁷ had conducted the study on Mangalore population between the ages of 7-16 years of age by generating a new regression equation. In their study 'canine' and 'second molar' contributed significantly to the fit, where as in the present study second molar and no. of teeth with closed apex contributed significantly to the fit. Differences between the present study and chandhini et al's report may have been caused by the differences in patient ratios. Their study did not show statistically significant differences in dental age estimation between male and female samples which suggest that gender did not show significant influence on age estimation.

Conclusion

The present study shows that there is a significant correlation between the chronological age and dental age estimated using Cameriere's method. The result indicated the suitability of normalized measurement of open apices of second molar and number of teeth with closed apex as developmental markers. A linear regression equation for both males and females has been derived which can be used in order to decrease the gap between the Chronologic age and dental age, so that a relative approximate age can be obtained. The present Regression equation is derived for age estimation from Indian children and hence this equation may be applied to estimate the age of Indian Population.

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